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Overgrazing: Is A Solution Available?

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Overgrazing is a growing problem which results in land degradation and a loss of habitat for local wildlife. This paper reviews overgrazing and reviews the degradation it causes, comparing the Sahel region in Africa to the Great Plains of the United States. Both areas have an enormous problem with overgrazing, a problem unlikely to be solved by technology. The only solution lies in a change of attitude and practice by the human population.

The term "overgrazing" is rapidly becoming a common expression in the ranching industry. Although most individuals associated with the grazing of cattle understand this concept, it has never adequately been defined. Overgrazing is the overuse of grassland for the purpose of grazing cattle. The problem with this definition is that it does not adequately define "overuse." Hardin (1968), referring to human population, stated that a maximum population is not the most beneficial for the welfare of humans. This same concept can be applied to cattle.

Why is overgrazing so harmful? Homewood and Rodgers (1987) report that if overgrazing is continued, its endpoint will be desertification. Desertification is the sustained decline and/or destruction of the biological productivity of arid and semiarid lands caused in large part by man-made stresses. If these stresses are continued, ecological degradation and desertlike conditions may arise (Wallace 1989).

Desertification can be very harmful to an ecosystem. Loss of vegetation, decrease in floral biodiversity, invasion by unwanted plant species, loss of animal population, increase in erosion, loss of minerals in soil, soil crusting and compacting, waterlogging, sedimentation, and a buildup in salinity in domestic and irrigation waters can all occur (Wallace 1989).

Is overgrazing just a term made up by environmentalists to scare ranchers into decreasing herd size? Won't these arid lands turn to desert anyway by climatic means? No. Since these areas are arid or semiarid, they are sensitive to change. However, historical evidence shows that natural climatic patterns produce cycles of drought, followed by periods of relatively higher rainfall. These cycles allow the system to recover. Only when full recovery is not possible does desertification actually occur. However, when this long-term change in ecosystem function has been observed, it is intervention by humans, not climatic change that appears to be responsible (Schlesinger et al. 1990).

When a system is not totally destroyed by overgrazing, its recovery is likely. Ballinger and Watts (1995) showed regrowth after the removal of cattle on a sandhills prairie in western Nebraska. When cattle were first removed, approximately 30% of the 150 x 150 m study grid was densely vegetated (over 50% of ground covered). After six years, that number increased to approximately 65%. After nine additional years, 15 years total, the area of dense vegetation grew to approximately 80%. Brown and Heske (1990) showed similar regrowth in a desert grassland community, but concluded the regrowth was directly affected by the removal of both cattle and of the kangaroo rats. The latter is a keystone species, usually vital to the maintenance of the habitat; however, the combination of cattle and kangaroo rats had over-stressed the grassland. This shows that regeneration of grasslands is possible if the entire system does not become desertified.

Overgrazing is not the only factor that contributes to desertification, but it is an important one. Farming, mining, energy production, and urbanization also contribute (Wallace, 1989), but for the purposes of this review grazing and overgrazing are the point of focus and the most important.

An important concept in this discussion is carrying capacity. Carrying capacity is the number of individuals that the resources of a habitat can support (Bush 1997). When the population is below the carrying capacity of a system, unused resources remain. In contrast, when a population is above a system's carrying capacity, environmental degradation occurs. This is what happens when overgrazing takes place (Homewood and Rodgers 1987).

Another concept that is relevant to this discussion is that of succession. Succession is the replacement of populations in a habitat through a regular progression (Ricklefs 1997). In other words, when herbivores eat one type of vegetation, another type is able to establish itself. Since most herbivores are selective grazers, this alters the

diet of the grazers, and their grazing potential. It also allows for invasion by exotic species.

All cases of overgrazing and desertification cannot be grouped together. This problem must be considered in a case-by-case manner. Important aspects to be considered when assessing overgrazing in an area are rainfall, soil minerals, grazing regime (Homewood and Rodgers, 1987), and social and economic factors. One of the most highly studied cases of overgrazing and desertification is the Sahel region of Africa. When looking at this ecological tragedy and comparing it to the Great Plains, a solution for one does not necessarily mean a solution for the other. However, a study of the Sahel situation may enable us to learn from their mistakes and avoid similar devastation in the Great Plains.

THE SAHEL

The Sahel is a region of grasses and forests that stretch across Africa south of the Sahara from Senegal to Chad. This area is a fragile belt that separates the Sahara from the rainforests in the south (Peterson 1990);(Smith 1993). Many studies have examined the cause of the Sahel desertification (Parsons 1988), (Peterson 1990), (Breman 1992), (Smith 1993).

The residents of this area were traditionally pastoral nomads (Smith 1993) who had very strict rules about grazing. For example, each tribe would select a strip of land to graze that was just a few miles wide, but hundreds of miles long. This would allow for two things; territorial marking and shifting of grazing areas. With these narrow strips of land, it was easy to determine which tribe resided in which area. This way a tribe would not mistakenly trespass on another tribe's territory. Also, with these strips being hundreds of miles long the nomads were able to shift their stock to a new area after the resources of the current grazing land started to become depleted. This allowed the grazed land to recover fully before being grazed again by the cattle.

Modern African countries' policies regarding this type of land utilization have led to an increase in sedentary grazing schemes (Smith, 1993). These schemes place a restriction on the movement of cattle which leads to the area being overgrazed, because the grazing occurs without allowing the land time to regenerate. This becomes especially important considering that the nomadic herdsmen formerly shifted cattle stocks in response to climatic shifts.

The utilization of fences is the major way cattle herds are restricted to an area. For this reason, fences are considered a contributing factor that may result in the degradation of grazing land. However, Peterson (1990) notes that fencing serves as a positive agent in decreasing wind erosion. There is an ICRISAT Sahelian Center in this region that had been surrounded by fences for six years, while the vegetation was left to grow on its own. Satellite photographs showed this area as an oasis of vegetation in the center of sandy, overgrazed land. This observation corresponds to a project erected sixteen years ago, which built wind blocks in Niger's Maggia Valley (Peterson 1990). This project consisted of double rows of trees 100 meters apart and 600 meters to one kilometer long, planted perpendicularly to the wind. These trees are harvested in four-year cycles by farmers, under strict laws and permits. The crops in this area are showing 18% greater yields than those without the windbreaks. An additional benefit is the use of these trees for energy; wood burning accounts for 90% of the Sahel's energy consumption. Even though these windblocks are used in this area for agriculture and not grazing purposes, it would be a logical idea to incorporate this knowledge into a solution for the desertification in this area caused by overgrazing.

In the 1960s and 1970s, the United States Agency for International Development (USAID) made an effort to help the people of the Sahel by drilling bore holes for water. By doing this they ignored the natural, traditional grazing pattern of pastoral nomads, and provided another incentive to remain sedentary (Smith 1993). Campbell (1986) notes that the areas around these bore holes have become even more degraded due to overgrazing, since the cattle congregate around the available water instead of migrating over a large area.

In assessing this situation it is necessary to comment on the single most important factor causing these soils to fail to rebound properly. Much of the grazing is done on marginal lands containing poor soils with low nutrient content (Peterson 1990). The overgrazing has added to the reduction of soil nutrient content, setting off a chain reaction which makes practically impossible the regeneration and rejuvenation of these grasslands. Adding this to wind erosion and soil compaction alters the entire composition of the soil. Breman (1992) reports that to the north in the Sahara, fertilizer application is becoming less effective, almost futile, since the soils are so compacted and unable to retain nutrients.

In the mid-Sahel region, which receives approximately 400 mm of rainfall annually, the nitrogen content of fully grown plants is so low that cattle have difficulty digesting them (Breman 1992). Even when going farther south into the savannah, the conditions do not improve. The forage of this area also has an extremely low nutrient level.

So what is being (or can be) done in this region to try to alleviate this problem? USAID's unsuccessful attempt to help solve the grazing problem through bore hole construction, and the possible use of windblocks to decrease erosion have been discussed. Breman (1992) states that "real social and economic development is the only way to desertification control." This poses a very difficult problem. First, cattle are not used only as a method of income, or even subsistence, in many regions of Africa, including the Sahel. They are a measure of stature and wealth, both culturally and socially. Parsons (1988) notes that the original domestication of cattle was for ritual or ceremonial purposes, and that only later was the use of cattle milk and meat incorporated into these societies. For this reason, reports Campbell (1986), even if a stock owner misuses the land, he is not criticized by others. By just having a herd of cattle, the owner earns prestige and wealth.

Another thing to consider is that seminomadic people in the Sahel raise a stock that has a protein production per hectare equal or greater to that of comparable arid regions of the United States or Australia (Breman 1992). The problem lies with the market prices for these animals. Smith (1993) found that as colonization occurred in Africa, head taxes were put on cattle. This forced pastoral nomads to increase herd size in order to meet these high fees. When these taxes were abandoned, the need for money increased as these nomads became consumers of manufactured goods. High market prices prompted these pastoralists to increase herd size, which led to overgrazing and, eventually, desertification.

An interesting argument is made as to the extent of degradation these systems are experiencing. Behnke et al. (1993) list four reasons the residents of this area are not destocking their cattle. The first is security against drought: the more cattle, the better off the residents are at surviving drought. This reason is not debated, and is relatively easy to understand. The second reason is the inequitable distribution of livestock among the people. This issue is important to understand, but it is a large argument that will not be discussed here. The third reason suggested is that decreasing the number of animals would decrease the number of people being supported. Last, many pastoralists do not feel their land is being degraded. One person's view of degradation may not be the same as another person's view. This leads back to the initial problem of not being able to accurately define overgrazing or degradation.

For these reasons, it seems that the only real means of solving this problem is through social and economic change. This does not seem likely in the near future, unless non-governmental organizations, inter-governmental organizations, and the government can get together to improve the conditions facing these pastoralists. A possible solution would be to allow the pastoralists to return to traditional nomadic practices, free of the borders imposed on them by the governments of these countries; this solution, however, would be a total reversal of current policy.

THE GREAT PLAINS

Although many residents of the United States might not realize it, overgrazing and desertification have become major issues in the ranching community. The overgrazing of cattle is ruining much of the habitat for the local wildlife. An historical background on the Great Plains, and an analysis of the damage humans have done to it in the past century, will aid understanding.

The grasslands of North America, on an ecological timescale, are very young (Bock and Bock 1995). Two hundred years ago they were vast open grasslands roamed by herds of bison, antelope, and wolves. Once the European settlers invaded this area and set up homesteads, the prairie became "disturbed." This makes it impossible for us to study this area as a pristine ecosystem.

The effects of grazing a grassland vary, depending on the types of grasses and the climate of the grassland. For example, bunchgrasses are deep-rooted species whose lateral growth is restricted to the formation of upright stems near the root crown (Bock and Bock 1995). However, sodgrasses, like buffalo grass and blue grama, spread laterally by the formation of horizontal stems that grow in the soil. This results in sodgrasses being more tolerable to grazing than bunchgrasses, since being eaten off close to the ground does less anatomical damage.

The grasslands of the Great Plains, obviously, were not new to grazing. After all, millions of bison and other herbivores once occupied this domain. This made the area tolerant to grazing once the European cow was introduced (Bock and Bock 1995). Milchunas et al. (1988) showed that grazing history has a large impact on a grasslands ability to support grazing, but it is not a good single explanatory variable.

Milchunas et al. (1988) explained that semiarid grasslands with a short grazing history are generally dominated by short- and intermediate-height grasses that have been selected for their tolerance to drought. This enables them to withstand some of the pressures of grazing. With these grasses, the effects of grazing are generally moderate, although they do have a high potential for invasion by exotic species because of the

relatively low rate of regrowth by the dominants. This is evident in the northwestern US and southwestern Canada, where heavy grazing has allowed the invasion of dominance by many Eurasian weeds. Bock and Bock (1995) report that relatively arid grasslands in the Great Plains do not change substantially after livestock exclusion, because the same grass species that survive grazing are best adapted to survive drought.

One particular study was performed at the Central Plains Experimental Range in north-central Colorado in 1939. This area was not previously overgrazed, but was divided into ungrazed, lightly grazed, moderately grazed, or heavily grazed sections for the purpose of this experiment. Up until 1966, this community did not exhibit any significant effects of grazing, with only minor effects detected in 1967-1970. Recent studies, however, show that subtle changes are still occurring after 45 years (Milchunas et al. 1988).

In the ranching states in the western and southern Great Plains, there has been a strongly heated debate between environmental groups and ranchers. The Bureau of Land Management (BLM) is the channel through which both sides are venting their frustration. The BLM is responsible for allocating and renting 270 million acres of public land to ranchers for cattle grazing (Nyberg 1990). This is where the debate gets interesting.

The BLM in Colorado, where 7.7 million acres of these public lands are rented by ranchers, found that only 23% of this land is in good or excellent condition (Scanlon 1990). This means it has less than half of the vegetation it would normally have if left ungrazed. This is an extremely low number, but it does seem to be improving. In 1984, only 18% of this land was rated as better than fair. The use of public lands contributes an estimated $200 million annually to the state's livestock industry (Nyberg, 1990).

Ranchers are receiving huge subsidies by being able to rent public land for grazing. In Colorado, ranchers are required to own some of their own land, while renting Forest Service or BLM land to increase the forage for their cattle. Nyberg (1990) reports that in 1990, the basic fee for this rental was $1.81 per animal unit month. An animal unit month (AUM) is the amount of forage consumed per month by one cow and calf pair. This is a fraction of what it would cost to rent or buy private land, and it is actually five cents lower than the fee for 1989 (Scanlon, 1990).

One particular case of manipulation of the public land system has been occurring for almost twenty years. Barker (1993) looked at the case of David Packard and William Hewlett, the founders of the Hewlett Packard computer conglomerate and two of the richest men in the United States, and their 90,000 acre tract of public land called the San Felipe Ranch. On this ranch 1800 head of cattle have been grazing since 1979, causing the land to be classified as poor-fair. This is arid land that is not suitable for livestock, so tax dollars paid for huge water tanks.

Barker (1993) also reports that in 1979 the BLM told the San Felipe Ranch to cut their stock by over one half. In 1979 the total AUMs of this land were 7393, and the BLM told the ranch to reduce this number to 3788. Upon receiving this news in 1979, Packard threatened to sue the BLM, so the BLM asked for phased-in reductions. As of 1991, these reductions have been ignored. In fact, in 1989, a drought year, the total AUMs of this land were 8375. This is 1000 more AUMs than what were reported originally when this land was said to be overgrazed. The ranchers say that while overgrazing did happen in the past, they have improved management practices so it is not a problem now.

Ranchers say that the land is in the best shape it has been in for the past one hundred years. Madson (1992) states that a typical attitude of ranchers in the West is that the overgrazing problem is just hype from environmentalists and Ph.D.s from the East. Ranchers are scared that the pressure from environmental groups might make the BLM buckle, without totally understanding both sides of the situation. This may lead to cuts or the end of grazing leases on public lands, or a considerable increase in grazing fees.

Ranchers in Colorado, according to Scanlon (1990), feel that 50 years ago there was a severe overgrazing problem, but that the problem is being resolved in the right direction today. Ranchers say that this is because of better range management techniques. It must be noted, however, that 50 years ago the Great Plains was in the Dust Bowl, the greatest drought this area has seen in recent history.

Bock and Bock (1995) show that careful livestock management can moderate the impacts of grazing, and some grasses actually respond better to being grazed than ungrazed. This is because grazing clears off much of the litter that may accumulate. There is a limit, however, to how much grazing pressure is tolerable to a grassland. When this limit is exceeded, the wildlife of an area is the thing that suffers.

One example of suffering wildlife is the mule deer of Wyoming (Collins, 1992). The dry conditions and overgrazing of grasslands has drastically reduced the winter foraging habitats of mule deer. This is hardly noticeable because the past few winters have been mild.

so the deer are doing well. However, once a harsh winter comes, it is speculated that noticeable devastation will be seen in the deer population. As of now, the BLM has trouble putting plans into effect to prevent this from happening, since wildlife receives little or no attention.

One wildlife population that is damaged by overgrazing is frequently overlooked. This is the mussel population in Texas. North America has the most diverse population of mussels in the world, with 51 species present. They are a complex culture that serves as a good bioindicator for environmental health. A recent study showed that 40% of the mussel species were in trouble (Legget, 1995). Their habitat is being destroyed by a combination of sand and silt, stemming from erosion due to overgrazing. This is distressful because mussels are not only important filters for the water (bacteria, algae, pesticides, and heavy metals), they are also used for food and tools by Native Americans in this region.

One of the most noticeable wildlife tragedies is in Nevada. America's largest wild horse herd, nearly 6000 animals, inhabits 2.2 million acres of Nellis Air Force range (Glover 1991). This range has been overgrazed, and the horses are starving to death. Because of drought conditions, there is not enough water to support even a third of the horse population.

Glover (1991) also shows how the wild horse populations in all of the western states are in trouble. In 1971, the Wild Free-Roaming Horse and Burro Act was passed, prohibiting the capture, sale or slaughter of wild horses. At this time, the population was 35,000. Today, the population is estimated between 50,000-75,000. This is above the carrying capacity of this area, and subsequently, many of these horses are starving to death. Recently, the BLM has been holding adoptions for many of these horses in order to try to decrease the stress put on their habitat.

There are examples, however, of heavily grazed land supporting certain populations better than ungrazed land. For example, heavily grazed land in North Dakota supports high densities of killdeer, horned larks, and chestnut-collared longspurs, whereas bobolink and savannah sparrows are abundant in ungrazed areas (Bock and Bock 1995).

CONCLUSION

Overgrazing damages a grassland system, sometimes beyond repair. Once the vegetation is stripped by grazers, soil erosion occurs. Combine this with soil compaction and nutrient loss, and the vegetation cannot rebound. This leads to invasion by exotic species, and a decline in edible foods for herbivores. Thus, overgrazing leads to a decline in local wildlife populations by destroying their habitat. Since one ecosystem is not working in isolation, other ecosystems that rely on the damaged one also suffer. As a result, populations of species living outside of the degraded area can also be affected. This can be seen in the mussel population discussed earlier. With all of these factors in mind, overgrazing can be defined as the occurrence of a population of grazers (usually cattle) utilizing an area which cannot support the population indefinitely without being allowed to recover.

Even though the solution for one case of desertification is not the same solution for another, it is possible for the Great Plains to learn from the tragedy in the Sahel. North Americans need to realize the complexity associated with a grassland ecosystem. If too many cattle are put on marginal land that cannot support them, the cattle will destroy the land, which can lead to desertification. This can already be seen in Africa, and the Great Plains are headed in that direction.

One major problem with the human culture is the reliance on a technological fix. It is human nature to think that we can do things to an ecosystem, and then be able to fix the problems with technology. The experience in the Sahel shows that even the most promising solutions (windblocks and bore holes) are not helping the problem. In fact, bore holes have increased the degradation.

There is also little hope in an economics-based solution. The pastoralists in the Sahel increased their herd size when they were taxed, and then increased it again when the taxes were lifted and they relied on material goods. Thus, decreasing subsides to ranchers or increasing market price would only provide incentive for the ranchers to increase herd size. On the same level, lowering market value would also invoke ranchers to increase herd size to make up for lost revenue. Either way, herd size increases and the problem becomes worse.

For this reason, a change in attitude, followed by a change in practice, needs to occur in order to halt the degradation of grasslands. This change is unlikely unless the government, the public, and various organizations get involved, since we are all affected by overgrazing in one way or another.

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REFERENCES CITED

Ballinger, R.E. and K.S. Watts
1995 Path to Extinction: Impact of Vegetational Change on Lizard Populations on Arapaho Prairie in the Nebraska Sandhills. *American Midland Naturalist* 134:413-417.

Barker, R.
1993 Lawsuit looms over troubled range. *(Idaho Falls, Idaho) Post Register*, 10 October.

Behnke, R.H., I. Scoones, and C. Kervan
1993 *Range Ecology at Disequilibrium*. Oversees Development Instutute, London.

Bock, J.H. and C.E. Bock
1995 The Challenges of Grassland Conservation. In *The Changing Prairie: North American Grasslands*, edited by A. Joern and K.H. Keeler, pp. 199-222. Oxford University Press, Oxford, New York.

Breman, H.
1992 Desertification Control, the West African Case; Prevention Better than Cure. *Biotropica* 24(2b):328-334.

Brown, J.H. and E.J. Heske
1990 Control of a Desert-Grassland Transition by a Keystone Rodent Guild. *Science* 250:1705-1708.

Bush, M.
1997 *Ecology of a Changing Planet*. Prentice Hall, Upper Saddle River, New Jersey.

Campbell, A.
1986 The use of wild food plants, and drought in Bostswana. *Journal of Arid Environments* 11:81-91.

Collins, K.
1992 Overgrazing, drought prompt G & F plan to cut Wyoming Range deer herd numbers: Area includes BLM's Cumberland Allotment. *Casper (Wyoming) Star Tribune*, 11 October.

Glover, M.
1991 Home on the range no more: Nevada's wild horses lack food, water, aid. *Sacramento (California) Bee*, 2 August.

Hardin, G.
1968 The Tragedy of the Commons. *Science* 162:1243-1248.

Homewood, K. and W.A. Rodgers
1987 Pastoralism, conservation and the overgrazing controversy. In *Conservation in Africa: peoples, policies, and practice*, edited by D. Anderson and R. Grove, pp. 111-128. Cambridge University Press, Cambrige.

Leggett, M.
1995 Checking out Texas' mussel strength: Biologist finds cause for concern about state's aquatic situation. *Austin (Texas) American-Statesman*, 16 April.

Madson, T.
1992 The BATTLE. *Missoullan (Missoula, Montana)*, 2 February.

Milchunas, D.G., O.E. Sala, and W.K. Lauenroth
1988 A generalized model of the effects of grazing by large herbivores on grassland community structure. *The American Naturalist* 132(1): 87-106.

Nyberg, B.
1990 Rangeland dispute reaches beyond western prairies. *Denver (Colorado) Post*, 14 January.

Parsons, J.J.
1988 The Scourge of Cows. *Whole Earth Review*, 40-47.

Peterson, S.
1990 Trees Put a Crimp in a Creeping Desert: An international project cultivates forested areas in Niger to provide a windbreak from the spreading Sahara. *The Christian Science Monitor* 1 October:15.

Ricklefs, R.E.
1997 *The Economy of Nature*. 4th Ed. W.H. Freeman, New York.

Scanlon, B.
1990 Grazing cattle anger group: Public land being eroded, environmentalists say. *(Boulder, Colorado) Daily Camera*, 19 January.

Schlesinger, W.H., J.J. Reynolds, G.L. Cunningham, L.F. Huenneke, W.M. Jarrell, R.A.Virginia, and W.G. Whitford
1990 Biological Feedbacks in Global Desertification. *Science* 247:1043-1047.

Smith, S.
1993 *World in Disorder: An Interdisciplinary Approach to Global Issues*. University Press of America, Lanham, Maryland.

Wallace, A.
1989 Estimating the potential for increased desertification with reclamation of arid lands. *Soil Science* 147(6):465-468.

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